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Memorandum 6M-3592

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Division 6 - Lincoln Laboratory
Massachusetts Institute of Technology
Lexington 73, Massachusetts

SUBJECT: BIWEEKLY REPORT FOR 6 MAY 1955

To: Jay W. Forrester

From: Division 6 Staff

COVER SHEET

The research reported in this document was supported jointly by the Department of the Army, the Department of the Navy, and the Department of the Air Force under Air Force Contract No. AF 19(122)-458.

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Approved: John C. Proctor

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INTRODUCTION

Bell System Training Program

(A. Vanderburgh) (UNCLASSIFIED)

An introductory training course for the Bell System engineers was held from 26 April to 6 May 1955. The topics covered were: An Analogous Humanly Operated Computing System (Notebook, Operator, and Adding Machine), A Sample Program for Above System, The Octal and Binary Number Systems, Computer Components, The MTC Adder Circuit, Copy or Transfer Circuits, Block Diagram of an Electronic Computer, Program and Operation Timing, A Sample Program (MTC Read-in), and Single vs. Multiple Address Computers. The class session was about 1 1/2 hours, consisting of a lecture and a question period. The course was conducted by A. Vanderburgh.

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I - SYSTEM TEST & PLANNING

1.1 Air Defense

1.1.1 Test Program (See also pages 16-17)

(D. R. Israel) (CONFIDENTIAL)

As a result of excellent cooperation from all concerned, the data-simulation and data-reduction programs required for the testing of the 1954 Cape Cod System are now almost fully completed. The week of 9 May will see the start of large-scale testing activities with the first initiation, tracking-accuracy, and track-monitoring tests.

Scheduling of all phases of the test program work through December 1955 is nearly completed. Detailed personnel assignments have been made, and a compilation of the computer, radar, and aircraft requirements is completed. During the week of 9 May, a schedule for all tests to be conducted through December will be drawn up in conjunction with the SAGE Test Office (STO) and Group 22.

We are now investigating with Group 22 the possibility of grouping the flight-test scheduling and coordination activities of Group 22 and Group 61 under the STO. Lincoln Grush of Group 22 would head up this activity. Such a move would relieve both Bob Davis and Anne Smalley of their current responsibilities and permit them to participate more actively in the test-planning and direction phases of the work.

The longer we consider the tests which should be conducted as a part of the Experimental SAGE Subsector Test Program, the greater the probable role of WWI and the 1954 CCS becomes. It now seems that operation of the 1954 CCS through 1956 is required. Our current estimates of computer and system time for XD-1 are 20 hours per week, starting in April 1956 and continuing at that level through 1957 at least. A similar figure of 20 hours per week is estimated for WWI through 1956. Further details are given in 6M-5003 and 6M-5005.

The SAGE Test Committee has decided to use the block of M-notes between 6M-5000 and 6M-6000 for all documents--Group 22, Group 61, BTL, and Lincoln Project Office of AFCRC--relating to the test program work on the 1954 CCS and the Experimental SAGE Subsector. Procedures and distribution are given in 6M-5000.

(E. Bedrosian) (CONFIDENTIAL)

The system-simulation program has been rewritten to handle a magnetic-tape read-in of simulated radar data. The simulation of interceptor data has been revised to accommodate the expansion from one to two interceptor simulator stations in the Training and Battle Simulation Room. The association phase of this program has also been rewritten.

The system-simulation program should be checked out during the next biweekly period.

(A. E. Budd) (CONFIDENTIAL)

The subroutine to read in data from magnetic-tape records has been written and is being checked out.

Some slight changes in specifications have caused the delay.

(O. T. Conant) (CONFIDENTIAL)

The past period was occupied with work on the track log printout program. This is a general purpose data-reduction routine and is described in 6M-3448 (draft, 3/14/55, J. Levenson). I hope to complete this program during the next biweekly period.

(R. Davis, A. Smalley, P. Dolan, R. Smith) (CONFIDENTIAL)

During this biweekly period there were no missions conducted for SAGE. However, operations did include nine fine-grain data tests in support of Division 2.

Of the nine, eight were completed successfully, and one was of doubtful value.

(F. W. Graham) (CONFIDENTIAL)

I am checking out a program for sine $(\theta + \Delta\theta)$.

(I. B. Hazel) (CONFIDENTIAL)

I am in the final phase of writing a program that logs an operations summary of recorded data made during operation of the 1954 Cape Cod System. I plan to have a program checked out during the next biweekly period.

This program will print out selected counts (viz. amount of radar data, number of tentative tracks, number of dropped tracks, number of light guns used, etc.) for each frame of time. At the completion of an operation cycle, a summary (i.e., the average per frame) of these items will be printed. For a complete list of items to be logged and modes of operation of the program, see Memorandum 6M-3448 by J. Levenson.

(H. A. Keit) (CONFIDENTIAL)

Work is continuing on the radar mapping study problem.

Completion of the magnetic-tape to tape-transfer program will be achieved during the next few days.

(D. Latimer) (CONFIDENTIAL)

I have completed the preliminary work on the "detailed single track history printout." There are six categories of information to be printed, and the program to print three of these categories will be checked out during the week of 9 May.

I am continuing to rewrite and organize tracking tables to be included in Memorandum 6M-3568, "1954 Cape Cod System Data Storage Tables."

(W. Z. Lemnios) (CONFIDENTIAL)

A rough draft of a survey memo outlining seven series of tests has been completed and is being circulated to interested persons for their comments.

Six more organizations have been invited to the June seminar on interceptor vectoring. This makes a total of 26 organizations to be invited. Thus far, 17 of them have answered, indicating that they will send 90 representatives who will give 18 formal talks. W. Wells and I expect to establish a definite program for these talks within a few days.

The data-sorting and data-analysis programs for the tracking-accuracy tests have been written by M. Curran, M. Smith, and A. Budd and are now being checked out.

(J. Levenson) (CONFIDENTIAL)

Test specifications have been issued for the first series of initiation tests on the 1954 Cape Cod System. A preliminary test is scheduled for 11 May to try the specified operating procedures.

Part of my time has been spent aiding in programming the post-test data-reduction routines and writing a test parameter for their checkout.

(S. Manber) (CONFIDENTIAL)

A revision of the 1954 Cape Cod System TBS room has been planned and will be completed during the next WWI installation day. Primarily, this change adds an additional interceptor simulator station to the present system. The procedures to be followed during the mapping test have been established, and these tests will be started the week of 16 May. Program changes required for the automatic initiation and the tracking-accuracy tests have been written but have not been checked out yet.

(A. Mathiasen) (CONFIDENTIAL)

The Raydist programs have been used in checking out the South Truro FGD system with at least a fair amount of success.

In a meeting on 5 May of George Harris (Group 22), George Sponsler (Group 25), Gerald Mahoney (S&EC Group), and myself, it was decided that, for the present, Mahoney would continue to check out the program which computes the latitude and longitude of a point given the Raydist lane counts using a method proposed by Sponsler. (See memorandum 22-SA-36.) A few selected points will then be processed by this program. We will then compare solutions for the three channels with each other and with those obtained from the present Raydist conversion program, T3719. This will determine what to do next. If the present program is adequate, this will end the matter. Otherwise a faster "exact" program will have to be devised, since Mahoney estimates that his program takes a minute to find one solution whereas T3719 takes a second. This rules out his program for possible future real-time applications and makes it impractical for extensive conversion.

Raydist records and tapes are now being kept by Maureen Cronin.

Memorandum 6M-3531, describing the Raydist calibration system, is awaiting publication.

Jack Nolan and I have split a general utility program which prints out and punches various information from the data-generation program. I am writing the output section.

(E. J. McEvoy) (CONFIDENTIAL)

I have been writing the program which will read in the preliminary Flexo tape for simulated data generation, convert it, and store the data in the correct format.

Other parts of the data generation have been written and are being checked out.

(R. L. Smith) (CONFIDENTIAL)

The center coordinates of the 5-inch DID scopes have been documented and will be issued as an addendum to the Cape Cod Equipment Notebook.

Drum storage allocation vs. CCS tapes indicating initial and final drum addresses have been compiled.

1.1.2 Analysis and Simulation

Manned-Interceptor Simulation

(H. Neumann, W. Wells) (CONFIDENTIAL)

The 51 cases of manned interceptions simulated by BTL on their NIP analog computer were run with our manned-interceptor simulation program, and the results were evaluated by the vectoring limits supplied by BTL. The results are being compared now.

Also, approximately 15% of the interceptions to be made to study the effects of quantization and radar scan rate were run. All parameter tapes are ready.

(B. Smulowicz) (CONFIDENTIAL)

Work is being continued on the correlation program to be used with the manned-interceptor simulation. The weather-clutter generator program has been written, and the block diagram of the correlation process is being completed.

Numerical Evaluation of Markov Processes

(C. Friedman) (CONFIDENTIAL)

Work continues on the analysis and comparison of the 1954 Cape Cod System of initiation with other schemes of automatic initiation.

Blip-Scan Data Analysis

(H. Houser, W. Wells) (CONFIDENTIAL)

An input-output program has been written to punch radar data stored on the MTC magnetic drum into IBM cards. Data punched on these cards can also be read back into the computer and stored on the magnetic drum with this program. Ten runs of radar data have been processed and punched out on IBM cards.

(B. Stahl, W. Wells) (CONFIDENTIAL)

Work is proceeding normally on an MTC program designed to analyze blip-scan data previously stored in the computer. A major portion of the program is now in coded form, and it is hoped it will be ready for initial checkout within a week.

A small amount of time was spent with details incident to the scheduling of future Raydist tests and with routine matters associated with the publication of the Raydist memorandum (6M-3531).

Radar Data Processing

(H. Peterson, W. Wells) (CONFIDENTIAL)

The program for mapping, using the area discriminator, has now been checked out.

A flow diagram of a program to test the effects of clutter on autoinitiation using these mapped data has been submitted for approval.

Track-Monitoring Test Series

(J. Nolan) (CONFIDENTIAL)

The first test of the track-monitoring test series will not be held until the week of 16 June. The postponement is due to delays in preparation of the computer programs needed to generate and process the test input data. The flight paths of the simulated aircraft tracks have been constructed by A. Smalley, and during the following week their time-position fixes will be transcribed onto punched paper tape for input to the data-generation program.

Radar Coordinating Committee Aid

(W. Wells) (CONFIDENTIAL)

Memorandum 6M-3565 has been submitted to the Radar Coordinating Committee (see report of F. Heart).

Triangulation from Passive Detectors

(R. Sittler) (CONFIDENTIAL)

Preliminary analysis has begun on the problem of using data from passive detectors (as when active jamming is present). A relation is being sought between the density of jammers and the density of ghosts.

1.1.3 SAGE Training

(S. Hibbard) (CONFIDENTIAL)

Representatives of the Air Training Command headed by Lt. Col. Lyman, USAF, visited Lincoln Laboratory on 26 and 27 April. The role ATC would play in the training phase of the SAGE System was discussed. ATC representatives expressed a desire to participate in the Experimental Training Course being generated by the 6520th Section "C" and Lincoln Training Section. They felt that participation by ATC was necessary if they were to acquire sufficient background training information to plan courses for the SAGE System.

The Training Section in conjunction with Group 38 and the 6520th Section "C" has prepared a series of slides, lectures, and manuals that will serve as training aids.

The Air Force system of personnel transfer requires a continuing course of instruction if Lincoln is to maintain qualified operators with which to conduct test and evaluation on Cape Cod and, in the near future, XD-1. It is toward this end that the present efforts of the Training Section are directed. It is hoped that the Experimental Training Course will provide a basis for a continuing training program.

1.1.4 Coordination

(M. Feldstein) (CONFIDENTIAL)

Memorandum 6M-3537, "Survey of the Facilities of the IBM Card Preparation Room," will be distributed the week of 9 May. This study estimates the volume of cards that will be processed to January 1957. An additional 056 card verifier machine has been ordered in light of the anticipated increase in cards to be punched and verified. Two operators will also be required.

Formats for schedules have been prepared. Detailed schedules are being prepared.

(A. P. Hill) (CONFIDENTIAL)

The major part of the past biweekly period was spent completing the syllabus for the SAGE System Familiarization Course that will be given from 9 May through 20 May. It is expected that some 60 people representing such organizations as BTL, WE, Naval Research Labs, Air Defense Command, Strategic Air Command, Boeing Aircraft, and Antiaircraft people will attend the course in addition to Lincoln Laboratory personnel.

SAGE Programming Information Service

(P. Bagley) (CONFIDENTIAL)

Memorandum 6M-3588 announces the establishment of the SAGE Programming Information Service (SPIS). The functions of this agency are to answer questions relating to computer programming in the SAGE System and to inform programmers of the basic facts needed for programming and of changes and additions to the System which affect programming. SPIS is under the Group 61 Coordination Section and is initially my responsibility.

Training

(P. Bagley) (CONFIDENTIAL)

Regular instruction has been provided in fundamentals of programming (for BTL staff) and in programming for XD-1 (for Group 61). Three seminars on the remote input and output equipments were held for interested Group 61 staff.

A survey of requirements for training SAGE programmers and test engineers is still in process.

A self-study course in fundamentals of programming is planned as an M-note.

Checkout of Air Defense Program Revisions

(L. R. Jeffery) (CONFIDENTIAL)

A proposal to use the Syracuse Combat Center for the checkout of air-defense program revisions is under study. The Rand Corporation will have responsibility for the revisions after the third Subsector installation. It is expected that the study will be completed before 1 June.

Additional details can be found in 6M-3567, "Study of a Proposal to Modify and Use one-half of the FSQ-8 equipment at Syracuse for Program Adaptation, Program Revision, and STP Checkout," by J. Jacobs.

Card-to-Tape and Tape-to-Card Conversion Equipment

Characteristics and availability of card-to-tape and tape-to-card conversion equipment for use by Israel's Section are being investigated. Mr. Jotberg of the IBM sales office in Salem will be here on Tuesday, 10 May, to discuss the matter.

1.1.5 Tracking

(W. Attridge, J. Ishihara) (CONFIDENTIAL)

Specifications for console labels in the air surveillance areas of XD-1 are being completed. Changes in console allocation at the Mapping Supervisor's position are now necessary because of the amount of control switches and indicator lights deemed necessary for the LRI and GFI monitors and cameras (this is true for the duplex centers as well as XD-1).

We have prepared a detailed schedule of jobs to be done in preparation of the operational specifications for the Tracking Section.

(D. L. Bailey) (CONFIDENTIAL)

An operational outline of automatic tracking and track detection in the SAGE System has been essentially completed by Attridge and myself.

Seward and I are organizing a lecture on track-while-scan for the coming SAGE System Familiarization Course.

A conference on the use of Mark X SIF has disclosed some interesting problems in the use of this data for tracking. I have been studying these and will develop a detailed plan in the near future.

(F. Brooks) (CONFIDENTIAL)

I have been working with W. Attridge and E. Wolf on operational outlines and on switch labels for radar-data inputs. The first draft of the manual-intervention utility program for XD-1 is completed, and on 9 May an attempt will be made to run it on the computer. Also a memo will soon be issued on (r,θ) to (x,y) conversion in the AN/FSQ-7.

(H. Seward) (CONFIDENTIAL)

A meeting among Arnow, Ishihara, and myself has resolved the general rules for operation of the crosstell function. A more detailed outline embodying these rules is being prepared.

Efforts were also made to attain familiarization with the input and output facilities of AN/FSQ-7.

(E. Wolf) (CONFIDENTIAL)

A third draft of the memorandum on SAGE System data conversion and transformation has been completed. The more general forms of the conversion and transformation equations, taking into account the elevations of the radars and of the planes of projection at the sites and at the center of coordinates, have been derived.

Switch-label specifications for the Mapping Supervisor and parts of the ASO stations have also been completed.

1.1.6 Program Organization

(R. L. Walquist) (CONFIDENTIAL)

Group 61 continues to make use of 1 hour per day of XD-1 time. The following table gives the percentage of usable time and the major causes of down time. The table indicates that the usable time is rather consistently decreasing. A linear least-squares fit of the data indicates that Group 61's usable time should drop to 0% around 20 June 1955.

Use of Group 61's Assigned XD-1 Time

Time Period	Usable Time	Causes of Down Time: Printer	Reader	Punch	Core Storage	Other
3/28-4/6	97.2%					2.8%
4/7-4/13	85%	1.7%	10%	3.3%		
4/14-4/20	70.2%		4.8%		25%	
4/21-4/27	72%		2%		6%	20%
4/28-5/4	51.7%	41.9%			1.6%	4.8%

The above figures are based on 1 hour per day operation, 5 days per week.

Work is continuing on time schedules for the Program Organization Section. Part of the problem is to obtain meaningful definitions of what work will be done by various individuals and what information will be forthcoming at each checkpoint of the time schedule. Arnow, Zraket, and I have spent considerable time deciding what belongs in ops specs and program specs. I am now working on definitions for coding specs, coding, checkout, etc. Providing these definitions is helping to clarify the task before us and helping to indicate where personnel are urgently needed.

(W. E. Ball) (CONFIDENTIAL)

The rough draft of Memorandum 6M-3568, "1954 Cape Cod System Data Storage Tables," (W. E. Ball, L. Collins, D. Latimer) which I have been compiling is nearly complete. The memo will be published later this month.

(H. D. Benington) (CONFIDENTIAL)

Documentation of the 1954 Cape Cod Program is almost finished. Master makeup and display (MMD) programming specifications have been completed by L. Collins; this memo, which has been compiled by eight MMD programmers, will be issued early during the next biweekly period. A memo summarizing all 1954 CCS storage registers is being compiled by W. Ball, L. Collins, and D. Latimer. All data has been collected so that the memo will be available during the next period.

Since the memo will be about 350 pages long, limited distribution is planned. Anyone interested in obtaining a copy should notify T. Finocchio, extension 165, Room C-170A. Finally, A. Chandler is completing a memo on 1954 CCS utility programs.

A new trace program is being written for Whirlwind; this program will have all features of the present trace program; in addition, it will be faster and more easily controlled. This work is being done by myself, J. Cox, and A. Schwartz.

R. Reed is taking over the SAGE display memo from A. Shoolman and myself. At a meeting with R. Everett and R. Fallows, it was decided that the material in this memo will not be used for wiring XD-1; and that the material should be considered as subject to 100% change in production installations. After Reed has completed the memo, he will continue coordinating display questions for Zraket and Arnow. Any associated programming questions will be considered by Schwartz.

Schedules for program organization work are being drawn up. The only definite assignments so far are that Schwartz will study and coordinate display problems; and that W. Harris will consider in-out and timing problems. This latter work will lead to the writing of a sequence-control program.

(L. B. Collins) (CONFIDENTIAL)

I have been engaged in the preparation of Memorandum 6M-2977, "Master Makeup and Display Program Specifications." It is expected that this memorandum will be completed during the week of 9 May.

(C. Gaudette, R. Gildea, S. Knapp, J. Yienger) (CONFIDENTIAL)

Three memos are being written. The first describes the octal print and basic track programs. The second describes the XD-1 assembly and read-in programs. The third lists the values of the sine of fine-grain azimuth units; these values are given in binary, octal, and decimal.

(P. L. Guinard) (CONFIDENTIAL)

Total Assigned Time

	hr	min
Program Checkout		
Utility		
Assembly	6	35
Down Time		
In-Out Equipment		
Computer Mal.	-	55
TOTAL	7	30

(W. F. Harris) (CONFIDENTIAL)

I have completed a study of the utilization of AN/FSQ-7 situation-display system off-centering and expansion facilities; the results of this study are detailed in Memorandum 6M-3549, entitled "Proposed Utilization of AN/FSQ-7 Off-Centering and Expansion Facilities for SAGE Subsectors 1-11." My work on geography displays is also completed and will be incorporated with work by H. Benington, A. Shoolman, and R. Reed in the AN/FSQ-7 situation-display specifications, to be issued.

I am now beginning a study of the problems involved in designing a sequence-control program for the SAGE master program. This study includes consideration of program sequence, drum transfers, and in-out timing.

(A. Shoolman) (CONFIDENTIAL)

I have completed 6M-3558, "Comments on Facilities for Setting Situation-Display Console Expansion Areas," dated 4 May 1955.

(P. Vance, A. Shoolman) (CONFIDENTIAL)

We have prepared our work schedule through 15 September 1955 and have nearly completed the draft of a memo describing alarm and intercommunication facilities for AN/FSQ-7 duplex operation.

1.1.7 Weapons Direction

(C. A. Zraket) (CONFIDENTIAL)

Requirements (AF personnel, radars, communications, and schedules) for the XD-1 Subsector have been reviewed with H. Anderson and H. Platt. The question of the XD-1 Subsector geographical boundaries has yet to be resolved in addition to whether and how XD-1 should cross-tell to WWI.

A Lincoln-SCEL meeting has been scheduled for 12 May at Lincoln on the subject of the integration of the AA System with SAGE. This meeting is a followup of the 20 April meeting reported in the last Biweekly.

A switch-panel layout and labels for the XD-1 Direction Center have been specified and given to H. Rising.

A definition and outline of operational, program, and coding specifications to be issued for the SAGE master program are now being prepared.

Proposals for the weapons assignment and control, intercept direction, antiaircraft, identification, manual inputs, height finding, raid forming, and Subsector Command Post functions in SAGE will be issued the week of 9 May in rough-draft form for discussion purposes.

(P. Bragar) (CONFIDENTIAL)

Responsibility for specifications for raid forming and for the Subsector Command Post has been assumed by the Weapons Direction Section. Previously prepared outlines of specifications for these areas are being revised for incorporation in the "Guide to Systems Operation."

(J. Cahill) (CONFIDENTIAL)

I have completed a draft of the operational specification for the SAGE Antiaircraft Direction Section. The draft will be circulated among interested persons for comment.

A meeting will be held at Lincoln on 12 May 1955 to discuss the proposed operational specification with representatives of interested Army agencies.

(A. Chandler) (CONFIDENTIAL)

I have been studying the problem of weapons direction in the SAGE System.

(H. Frachtman) (CONFIDENTIAL)

The outline of the height-finding operations specifications for the SAGE System has been revised and enlarged.

(C. Grandy) (CONFIDENTIAL)

R. Nelson, A. Chandler, and I have divided the work in Weapons Direction as follows:

Chandler and Grandy

Threat evaluation
Weapon deployment
Weapons allocation
Track responsibility assignment
Weapons assignment

Nelson

Weapons crosstelling
Intercept direction

P. Bragar, who has transferred to the WD Section, will continue to work on raid forming and Subsector Command Post operation. I will coordinate all of these activities.

A time schedule for operational specifications and program specifications for Weapons Direction has been drawn up by A. Chandler, R. Nelson, and me. A similar schedule for raid forming and Subsector Command Post specifications has been prepared with P. Bragar. The schedules show our allocation of effort to prepare operational specifications in draft form by 1 July 1955 and program specifications by 1 October 1955. Time has been allowed in the schedules for staff vacations.

A preliminary draft of material on weapons assignment and control has been prepared by A. Chandler and me. This material, which is a proposal for system operation, will eventually become a part of the "Guide to Systems Operation." Copies (ditto) will be available by 11 May 1955. (This is 2 days behind the schedule mentioned above.)

Direction Center console-equipment allocations for XD-1 and duplex installations weapons direction, height, identification, Command Post, AA raid forming, and manual inputs were reviewed by members of the Weapons Direction Section. Several minor changes were made in the allocation, and in addition, digital-display scopes were added for the Senior Director's Technician and for each Weapons Director's Technician. The revised allocations will be documented by H. Rising in formal memoranda.

Labels for the intervention switches at the stations have also been specified by members of the Section, and this change is anticipated in the labels for several consoles; an over-all review of labels will be made after the operational specifications are written.

(S. Hauser, F. Garth) (CONFIDENTIAL)

We are writing a memo on the subject of identification operation which is to be included in the "Guide to System Operation." This is a working memo to which we will refer in writing the final draft of operational specifications.

(R. Nelson) (CONFIDENTIAL)

I am helping to prepare the "Guide to System Operation" for the Weapons Direction Section of the Direction Center; for this I am personally concerned with weapons crosstelling and intercept direction.

1.1.8 Special Studies

(A. Favret) (CONFIDENTIAL)

On 5 May 1955, with J. Arnow, and H. Rising, I attended a meeting at Bell Telephone Laboratories, West Street, New York City, to discuss communications between FSQ-7 and Talos Defense Units. A subsequent meeting on the same subject is planned for 13 May at ADES, Church Street, with a large number of agencies participating.

(F. Heart) (CONFIDENTIAL)

I have continued to attend meetings of the Lincoln Radar Coordinating Committee in support of that effort. Group 61 was asked to comment upon radar-data requirements for the next few years. After soliciting the comments of about 20 Group 61 members a memorandum was issued which outlined best present estimates (6M-3565, Wells, Heart). We would like to thank the interested persons in Group 61 for their rapid response.

Effort is continuing on study of the azimuth - only tracking problems. The results have continued to be inconclusive.

On 28 April 1955 two officials of the Canadian Research and Development Board visited the Laboratory to discuss various general questions about the SAGE System. This visit is reported in an interoffice memorandum to C. R. Wieser.

1.1.1 Test Program (Continued)

(W. Vecchia) (CONFIDENTIAL)

	hr	min
Total Assigned Time	121	30
Extra Assigned Time	3	30
	125	

	hr	min
Analysis	42	10
Tracking	14	15
Raydist	17	10
Weapons Direction	4	55
Equipment Checkout	5	
System Operation	6	15
TOTAL	89	45

(CONTINUED)

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	hr	min
Time Given Systems	33	
Time Given 6345	1	
Time Given Ackley	1	
Time Lost Computer (malfunction)		15
TOTAL	35	15

	hr	min
	89	45
	35	15
GRAND TOTAL	125	

1.2 Whirlwind I

1.2.2 WWI System Operation

Records of Operation

(J. P. White, B. H. Jacobs) (UNCLASSIFIED)

The following is an estimate by the computer operators of the usable percentage of assigned operation time and the number of computer errors for the period 22 April 1955 - 6 May 1955:

Number of assigned hours	166
Usable percentage of assigned time	97
Usable percentage of assigned time since March 1951	90
Usable percentage of assigned time since September 1953	94
Number of transient errors	4
Number of steady-state errors	6
Number of intermittent errors	2

Analysis of WWI Failures

(A. R. Curtiss) (UNCLASSIFIED)

The following is a breakdown of interrupting and potentially interrupting failures occurring in the WWI computer system for the bi-weekly period, 22 April - 6 May 1955, inclusive:

Total Number of Failures	24
Total Number of No-Lost-Time Failures	1
Total Number of Lost-Time Failures	23
Total Lost Time in Hours	10
Total Operating Time in Hours	291.5

Class of Failure	Essential Maintenance		Chargeable to System			
			Explained		Unexplained	
	No.	Min.Lost	No.	Min.Lost	No.	Min.Lost
Tubes	1	15	1	10		
Passive Electrical Components	1	35	1	0		
Fuses					1	18
Alarms			2	25	11	268
Miscellaneous	1	10	2	128	3	85
Number of Lost-Time Incidents	3	60	5	163	15	371
Number of No-Lost-Time Incidents			1	0		

(L. L. Holmes, A. J. Roberts) (UNCLASSIFIED)

There were 24 incidents of interruption resulting in 10 hours of down time during 293 computer operating hours. The average uninterrupted operating time between incidents was 11.5 hours. Transient alarms accounted for half of the failures. A total of 5 hours of lost time was a consequence of two steady-state failures.

Applications work was stopped for 1.5 hours when the computer display system showed the effects of a 1-v ripple on the +150-v power supply. Photographs of displays during the 1.5-hour period were impossible to interpret. The trouble has been temporarily cured by raising the input voltage to the power supply.

A failure to record a zero in digit 5 of both magnetic drums caused the loss of 3.5 hours. The reason for the failure is believed to have been an improperly seated cathode follower or a poor video cable connection.

FGD Tests

(L. L. Holmes, C. S. Lin, A. J. Roberts) (UNCLASSIFIED)

There was a meeting of interested parties from Groups 22, 24, and 64 on 26 April to discuss the evaluation of the FGD system. It was decided that an intensified evaluation program should be launched. The evaluation process consists of the simultaneous tracking of an identified aircraft by the FGD system and by Raydist. The data from FGD is compared with that of the Raydist for errors. Since the meeting, eight missions have been scheduled and completed. At the end of each mission, the FGD data is plotted on large graph paper to detect apparent azimuth and range jitters. Later, when Raydist data has been processed and is available, it is fed into WWI together with the FGD data for comparison. The results have been encouraging. The latest test runs, of 5 and 6 May, yielded smooth tracks with only occasional range and azimuth jumps. Because of the time required to process the Raydist, no quantitative analysis can be made of the latest runs at this date.

(D. A. Morrison) (UNCLASSIFIED)

Memorandum M-2184, "Marginal Checking System Mod. II, WWI," is being reworked to include latest circuit revisions.

The photoelectric tape reader test program, T-3232, part of the WWI consolidated test program, T-3432, has been modified to check for the proper test tape in the reader prior to the start of the marginal-checking routine. The new program, T-3232 m105, also allows for repeating the test, using the second reader, when so requested.

I have been assigned to work with T. Sandy on the WWI in-out system.

1.2.3 Terminal Equipment

(C. S. Lin, L. D. Healy) (UNCLASSIFIED)

It appears that tube unbalance makes the use of the regular drum writer circuits for an automatic erase system impossible. No new system is envisioned to replace the present method of erasing.

(T. Sandy) (UNCLASSIFIED)

The display numerical generator, WWI, was realigned.

Ampex 14-Channel Recorder

(A. Shortell, N. Alperin) (UNCLASSIFIED)

The playback preamplifier panel has been received from the shop and is being checked. No further work has been done on the computer check of the recorders, as the equipment for generating an SDV test pattern is being modified.

Radar Inputs

(A. Shortell, N. Alperin) (UNCLASSIFIED)

Group 22 reports that the changing ratios in the SDV signal were due to the thermal effects in the mixing resistors. To counteract these effects precision resistors will be used. It should now be possible (at long last) to lock the pots in a demodulator when a site has made this modification. All gap fillers will be modified by 13 May. We have the benefit of 1 week's experience with the data from Martha's Vineyard. The results have been excellent.

Maintenance Programming

(J. N. Ackley) (UNCLASSIFIED)

C. S. Lin and I are preparing a proposal for a real-time Raydist tracking system. Our proposal includes a digital phase indicator which essentially counts the difference in the number of zero crossovers of two audio tones but will quantize the phase reading to any reasonable degree of accuracy.

Two events have pointed out that computer-programmed checks will be needed for a radar-input system before it is returned from a maintenance to an operational period. In one test, the direct printout from the computer showed that the last two bits of range were always ones. This trouble was traced to a maintenance switch which had been left in the "test" position. Azimuth jumps caused by maladjustment of a detector circuit were brought quickly in evidence by the printout. Neither of these troubles could have been seen on a monitor scope.

Work on a multiple-aircraft tracking program for radar evaluation has slowed until I can get a better idea from the operational groups exactly what data they need and in what form they want it presented.

I have written some (30,15) programmed-arithmetic subroutines for general use which should be at least twice as fast as the present (24,6) comprehensive system. A decrease in operating time is traded for an increase in the storage space required for the subroutines.

Typewriter and Paper Tape

(L. H. Norcott) (UNCLASSIFIED)

Another tape comparer is being constructed for use in the Tape Preparation Room.

One of the four punches at Lexington has been modified to punch our heavy gray tape. The remaining punches will be so modified by 1 June.

Power Supply

(E. Pughe) (UNCLASSIFIED)

Blown-fuse indicator lights have been installed on the +200-v power supply series-tube panels.

The rectifier voltages on the -60-v and -450-v power supplies have been lowered to reduce the plate dissipation of the series tubes. New plate transformers are needed for the +200-v supply to reduce the series-tube plate dissipation to rated value.

Agreement has not yet been reached on the type of foundation for the new WWI filament alternator. I prefer a grouted foundation, while Mr. A. R. Smith prefers the bed plate supported at six points.

The 550-v circuit for the new WWI filament alternator has been connected to the building distribution system.

II - AN/FSQ-7

2.1 Liaison

2.1.1 System

Production Coordination Office

(A. P. Kromer) (UNCLASSIFIED)

In connection with the SAGE System program it has become increasingly apparent that various organizations plan to send a relatively large number of personnel to work temporarily at Lincoln Laboratory to acquire background experience in operation of the Experimental Subsector. Data concerning the number of people and the time phasing of their activity here has been gathered and summarized in Lincoln Laboratory Memorandum 6M-3575. This clearly indicates the need for a significant amount of additional office space to be made available on a very short time scale. This matter was discussed with the Air Force at a meeting on 5 May and is to receive further consideration following consideration and revision of the estimated figures contained in the above-mentioned M-note.

Other activities of the Production Coordination Office have included consolidation of data for discussion purposes at the regular Monthly ADES Status Meeting which is scheduled for Tuesday, 10 May, continued work in connection with development of a suitable method of securing controlled lighting conditions in the operation room of the Direction Centers, and release of TIR's covering SAGE System requirements and specifications.

(F. F. Manning, J. J. Carson, W. H. Ayer) (UNCLASSIFIED)

Current information on the Experimental SAGE Subsector has been prepared for the May issue of the WE-ADES SAGE Status and Progress Report. The Division 6 section of this report contains (1) a brief description of the Experimental SAGE Subsector, (2) engineering comments and recommendations on any phase of the program that is not adhering to the firmed-up schedule dates, and (3) the status of the various groups of equipment.

The SAGE Experimental Subsector schedule (B-75119-2) was posted on 2 May 1955 by extrapolating from the latest information available. Firmed-up information will be confirmed at the Schedule Meeting at Poughkeepsie, 5 May 1955.

We are continuing to collect backup information for scheduling and followup purposes.

(E. L. Smiley, W. H. Ayer) (UNCLASSIFIED)

The Allied Construction Phasing Subcommittee has prepared a preliminary schedule for the first DC-CC combination. Construction is expected to start on or about 5 May 1955.

The revised layout of the Manual Inputs Room, as shown on drawing C-62459, has received IBM concurrence. We also have a note from S. Hauser, approved by C. Zraket, approving this layout. ADC will not approve until the number of teletypes in this room has been definitely defined by WE-ADES and ADC. However, in order to prevent delays in the building construction, we are proceeding on the theory that this plan will be approved. The number of teletypes is not a critical factor in the equipment layout of this room as long as the quantities shown do not increase by more than a factor of two (2).

The light-testing room (B-034) has been equipped with a honeycomb ceiling (cell size 3/8" on a side, panel size 2' x 4' x 1"). Extruded blue plastic filters in tubular form will be installed over the fluorescent bulbs on or about 6 May 1955. Preliminary observations indicate that it will be necessary to paint the ceiling a darker shade than the present "dove gray." In general, it appears that the system presently under investigation will be the most practical and satisfactory solution. It is expected that the room will be ready for readability tests by 13 May 1955 and that specifications for a lighting system will be written within the next biweekly period.

Technical Information Release

(E. D. Lundberg, J. J. Carson) (UNCLASSIFIED)

The following material has been released as engineering data for AN/FSQ-7 and SAGE System.

TIR	M-Note	Subject
1-73	6M-3159-1	Summary Equipment List for SAGE System Direction Centers (including release of IBM report IM-102-2)

2.2 XD-1, XD-2

2.2.1 Systems

(H. Anderson, I. Aronson, H. Platt) (UNCLASSIFIED)

Only one meeting of the Planning Approval Committee was held during this period. Discussion at this meeting pointed to a need for a unified summary of the equipment and sites in the Experimental Subsector. At a later subcommittee meeting, this summary was written as a draft

proposal and is now being circulated for comments. It will be issued as 6M-3515-1.

The major items that we are now concerned with are the area of responsibility chart, the XD-1 time allocation chart, and the military manpower requirements. All three of these items will be finished during the week of 9 May.

(J. Giordano) (UNCLASSIFIED)

Recent IBM-SO concurrence on prototype and production specifications is listed in 6M-3589, "Minutes of the IBM-SO Concurrence Meeting #26."

The physical layout of drawing D-75123, Command Post Room in Building F, has received Group 61 release, ADC approval, and IBM concurrence.

(A. M. Werlin) (UNCLASSIFIED)

A study is being made of the feasibility of inserting the crosstelling-output message of XD-1 into the WWI input system, and also of the incorporation of an output system for WWI to provide a message for the XD-1 crosstelling-input system.

Input Pattern Generators (XD-1)

(J. P. May) (UNCLASSIFIED)

The "Specifications for the Input Pattern Generators" (IBM Document P-186) for the gap filler, long-range radar, and crosstelling inputs were concurred upon by IBM and the Systems Office. The minor revisions to P-186 are stated in the concurrence letter.

Logical Services Committee

(N. T. Jones, R. D. Buzzard) (UNCLASSIFIED)

Command Post DD Desk. The desk designs have been refined and modified to optimize the height, in order to allow the desk operators greatest ease in viewing the screen. The latest designs are now being drawn up by the Drafting Room. We have initiated construction of a plywood mockup of these designs, estimated to be completed by 27 May.

The desk specifications were discussed at the concurrence meetings on 28 April and 5 May and should be ready for concurrence on 12 May.

Large-Board Display. The specifications for the large-board display, 6M-3439-2, were concurred upon at the meeting of 28 April.

Automatic Camera. "Specifications for Automatic Camera and Control for AN/FSQ-7," 6M-2877 Supplement 6, written by L. Sutro, were agreed upon at the meeting of 28 April.

LRI Monitor

(J. McCusker) (UNCLASSIFIED)

The conversion of r-θ digital data to x-y analog data will be done by the multiplication of $\pm\sin\theta$ and $\pm\cos\theta$ by 'r' in two analog multipliers. The transcendental terms are formed by two linear vacuum-tube decoders and four diode-slicing networks which convert digital 'θ' to analog sine and cosine voltages. Arrangements are being made to display converted results on MTC.

2.2.2 Installation

Communications

(H. J. Kirshner, C. J. Carter) (UNCLASSIFIED)

A conference was held among EADF, Lincoln, and AFCRC for the purpose of finding a solution to the problem of telephone equipment and entrance facilities at ADC sites. It appears that the most expeditious solution is for AFCRC to order and for the Telephone Company to install any new facilities which may be required. Current USAF policy permits the Telephone Company to carry its circuits beyond "the fence" at ADC bases.

The installation of telephone equipment in the first display console and the maintenance console was completed on 5 May 1955.

The cutover of the Building F 701-A dial system and 607-A switchboard is scheduled for 21 May 1955.

XD-1 Installation Information - Report #34 (Extract)

(H. Mercer, H. Wainwright) (UNCLASSIFIED)

I. Building Construction

The Air Force has accepted the interior of Building F, with the exception of the lock cylinders. The contractor has started outside finishing and grading.

II. Equipment Cooling

The contractor no longer has an installation crew on the job. Work to be accomplished is hookup of new frames, as they are delivered, and continued testing and checking of the control panels.

Additional ductwork for new drum frames and Command Post will be installed later.

III. Cabling

The work required of the Livingston Company was completed by 29 April. Remaining cable installations will be completed by IBM/Lincoln technicians or Lincoln electricians.

Prefabbed console cables as delivered to Building F to date cannot be installed because of improper orientation between the console and cable connectors. A check with the IBM cable design group reveals that this condition will exist with the entire run of cables now in production, about 469 cables involved. Of these 469, 116 are on hand and are to be corrected by the Division 6 electrical and inspection shop.

Power cabling is all installed, but, as previously reported, final hookup must await remaining frame delivery.

Display-cable production is about 80% complete, with about 30% delivered at Kingston and 15% delivered at Building F.

IV. Equipment Layout

Projection Room - Air Force approval has been received for the layout. We expect that revised structural drawings and specifications will be completed during the week of 9 May. Actual alterations in the area will get under way as quickly as possible.

V. Lighting

Evaluation of various louvered ceiling designs and color requirements continues in B-034.

VI. Telephones

The entire Building F installation is between 65 and 70% complete. According to C. Carter of Group 64, the installation is on schedule.

VII. General

With Air Force acceptance of the interior of the building, many of the problems connected with servicing Building F and its equipment will no longer exist. Division 1 will be responsible for building operations and will provide electricians and mechanics for electrical and equipment-cooling operation and maintenance.

In addition, Division 1 will handle modifications and building alterations, as required, by either doing the work themselves or by subcontracting the work.

2.2.3 Testing

(J. A. O'Brien) (UNCLASSIFIED)

Basic agreement has been reached between Lincoln and IBM on what is to be included in the acceptance tests on the XD-1 equipment. The first tests will be on the central-computer equipment and will probably be run during June. The evaluation will consider data from several concentrated test runs, as well as the data on normal daily operations.

(S. L. Thompson) (UNCLASSIFIED)

The "sandwich" program has been prepared, to control the operation of four system-test programs concurrently. Because the system-test programs are not yet ready, a special program to test the sandwich program has also been written. These programs will be tested when computer time is available.

XD-1 Records

(J. D. Crane) (UNCLASSIFIED)

A complete review of the XD-1 log system has been made. As a result, forms which allow check-off entry of information, in a manner suitable for punching into IBM cards, have been made up for trial use by computer operating personnel.

XD-1 Memory

(W. J. Canty) (UNCLASSIFIED)

Conferences were held in Poughkeepsie on Monday and Tuesday, 2 and 3 May, to disseminate information about XD-1 memory problems.

It appears that two main problems are present in the XD-1 memory. The first is that the regulation of currents on any selected line, as a function of information being read out or inserted in memory, is much poorer than originally expected. Current variations well above 40 milliamperes have been observed during operation of memory test programs. The second major problem in memory is that of the sense amplifier. Both the gain and bandwidth of the present sense amplifiers are inadequate for reliable operation of memory. While these are major problems which must be solved before reliable operation can be expected, there are other

problems which should be corrected on a long-term basis, to ease memory timing adjustments. Included is redesign of the memory gate generator, digit-plane driver, and memory buffer-register power cathode-follower circuits.

As yet, there are no definite solutions to these problems. IBM people at Poughkeepsie have proposed increasing the current-measuring resistors at the top and bottom of each core-memory stack from 5 ohms to 20 ohms. This proposal is now undergoing study and testing. This may be only a short-term solution, however.

Power

(R. C. Jahn) (UNCLASSIFIED)

The PCD ammeter for direct currents is subject to errors of from 10% to 50% or more. The cause of these errors is the use of a common bus connection for several ammeter shunts. Small voltages on the bus, between the shunt terminal which should be used and the common point, are added to the shunt voltage. A wafer switch ganged to the ammeter selector switch should correct these errors.

D-C Supplies

(J. Clarke) (UNCLASSIFIED)

A new 18-kw load-bank has been built to determine load regulation of low-voltage supplies (under 90 volts) of XD-1. It has incorporated in it a switching means for obtaining a 2-cycle and 6-cycle transient, to simulate a fault with 2- and 6-cycle breakers. The load-bank can also be used to determine line regulation of all supplies by inserting it in series with the line.

Power Distribution

(G. F. Sandy) (UNCLASSIFIED)

Twenty-eight Struthers-Dunn relays on the central computer MCD frame were replaced with improved Struthers-Dunn relays on Saturday, 30 April. It is hoped that these relays will have a much lower failure rate and will contribute materially to the improvement of the reliability of the XD-1 system.

2.3 Production System

(S. H. Dodd) (UNCLASSIFIED)

It is becoming increasingly clear that the line is nebulous between the planning activities for the duplex and XD-1 installations. In view of this, and because of recent personnel transfers from the Systems Office, the Group 62 and 64 activities in these areas are being reviewed. The efforts of the two Groups will be reorganized during the next biweekly period on the basis of this review.

It is planned to incorporate as much Cape Cod experience as possible into the Lincoln activity on the Experimental Subsector. As a start in this direction E. S. Rich will supervise the test planning. C. W. Watt, Jr., has taken temporary leave to work with the Cape Cod System with a view to providing liaison between that installation and the Experimental Subsector.

T. R. Parkins has assumed the duties of my assistant, effective immediately.

(K. E. McVicar) (UNCLASSIFIED)

As part of my work with the ADES System Operation and Testing Subcommittee, I have been assisting in a rewrite of the subcommittee report for the McGuire Subsector. This document has been circulated for comments prior to its issue with a TIR.

We are now accumulating the information necessary to produce a similar report for the Stewart and Syracuse Subsectors.

(B. E. Morriss) (UNCLASSIFIED)

A note describing the differences between XD-1 and the first production FSQ-7 is in preparation. This note is being edited by R. P. Mayer.

The question of new outputs for uses such as ground-to-air data link and AAA is coming up more frequently; therefore, IBM-Lincoln Outputs Committee has been revived. First task of this group will be to write up a brief history of the ground-to-air time-division data link and the technical aspects of the connection for the Direction Center to an AAOC. Also being investigated with tests to be run on MTC will be the improvement in air detection by the use of the interleaving messages. The interleaving is being investigated with many of the potential output customers expressing doubt as to the usefulness of the interleaving technique. It has been discovered that Group 24 is also investigating methods of constructing an LRI monitor. Efforts to date will be discussed to prevent a duplication of work.

Specifications of equipment to produce a large-board display have been agreed upon with IBM, pending Air Force approval of the type of display. The specifications have been forwarded to Air Force representatives for their comments. New sketches of the Command Post Digital Display Desk have been prepared following the last round of comments. Mockups of the two most promising layouts will be constructed.

Estimates of the heat dissipation by frames have been received from IBM. These estimates were to be incorporated in air-conditioning drawings to be sent to ADES-Western Electric, because these estimates differed significantly from measured value for the few frames of which measurements have been taken. Power group is now taking rough measurements on all frames now installed in Building F.

(T. R. Parkins) (UNCLASSIFIED)

During this period I assisted Ken McVicar in the preparation of external communications requirements in McGuire Subsector. This work has been incorporated in the ADES System Operation and Testing Subcommittee Progress Report.

On 6 May I attended the monthly Project High Progress Meeting at IBM-Kingston, New York. A report of the meeting is being prepared for personnel concerned in Group 66.

Communications

(H. J. Kirshner) (UNCLASSIFIED)

Dates for telephone service for Subsectors 1 and 2 based on the needs of the System Operation and Test Subcommittee were submitted to ADC, ADES, and AT&T Co. at a meeting at Lexington.

Digital Data Transmitters and Receivers

(F. E. Irish) (UNCLASSIFIED)

A meeting was held on 27 April with IBM, BTL, and Lincoln attending to discuss the draft of an IBM-Lincoln concurrence letter, "Concurrence on D-66, Fundamental Technical Requirements for DDT's, DDR's, and Associated Equipment." This letter contained IBM's interpretations of the BTL prospectus on DDR's and DDT's. These interpretations mainly concerned the transmission of control signals between the DDR's and the AN/FSQ-7 computer. BTL agreed with most of the interpretations but wished for clarity's sake to express them in the form of a rough circuit schematic. As soon as we receive this schematic and any other comments from BTL we shall be able to concur on the document, D-66.

Reliability of Duplexed Equipment

(R. C. Jeffrey) (UNCLASSIFIED)

A preliminary report on this subject (6M-3441) has been completed and will be distributed during the week of 9 May.

Outputs

(S. B. Ginsburg) (UNCLASSIFIED)

Consideration is presently directed towards generating a program to operate with MTC which will adequately test the feasibility for interleaved or noninterleaved crosstell messages.

Some thought has also been given to the equipment requirements for transmitting a crosstell message from WWI to XD-1.

Input Pattern Generators

(J. P. May) (UNCLASSIFIED)

"Specifications for the Input Pattern Generator, D-74-2," were concurred upon by IBM and the Systems Office. The revisions necessary to obtain concurrence are included in the concurrence letter.

Long-Range-Radar Input Monitor

(A. D. Hughes, J. P. May, A. M. Werlin) (UNCLASSIFIED)

A draft of the tentative "LRI Monitor Specifications for AN/FSQ-7," 6M-3579, has been written by a committee of IBM and Lincoln personnel and distributed for comment. When all comments are received, the draft will be reviewed and proposed for concurrence.

Power Generation

(J. J. Gano) (UNCLASSIFIED)

Memorandum 6M-3378, "Power Generation and Distribution for the Sage System, Fourth and Subsequent Sites," which has been approved by Western Electric and IBM, and Memorandum 6M-3590, "Transient Analysis of Power Supply for Sage System Direction Center," a report in which Jackson and Moreland investigated the generating plant described in the first memo, have been published and should be ready for distribution the week of 9 May.

Power Graphic Panel

(A. S. Chopourian) (UNCLASSIFIED)

Specifications for the graphic panel for the production FSQ-7 are being written. The philosophy behind the panel is to provide to the computer operating personnel information concerning the status of the power and equipment-cooling systems.

Filament Power

(S. Coffin) (UNCLASSIFIED)

I have been conducting tests and gathering data on the properties of vacuum-tube filaments to determine the most desirable method and rate of voltage application for AN/FSQ-7. Tests show that (1) in general, small filaments reach temperature equilibrium faster than larger filaments, (2) of the common tubes in AN/FSQ-7, the 2420, 5965, and 6136 have nearly identical warmup characteristics, but the 5998 is slower by a factor of two, and (3) warming up a representative combination of these tubes using constant current takes about 50 seconds.

The problem is to find a simple cycling up device which can be used in each load frame. The trouble with XD-1 is that the filament cycling is done only at the main source and individual frames cannot be cycled on or off slowly.

Power Distribution

(G. F. Sandy) (UNCLASSIFIED)

The present method of applying filament voltage to the AN/FSQ-7 equipment leaves much to be desired. The filament voltage is increased gradually from the residual voltage of the filament generator to full voltage over a 1-minute period. This method is good when the entire system is to be brought on. However, if power is already on to the system with one or two frames turned off, these frames may be turned on locally, applying full voltage directly to the filaments of the tubes in these frames.

Various proposals have been made to overcome this undesirable feature. A promising possibility is to insert a thermistor in series with the regulated a-c lines to each frame. The large negative temperature coefficient of resistance of the thermistor should limit the inrush current, yet allow very nearly full current to flow after the filaments are hot. Several thermistors have been ordered to test the feasibility of using them for this purpose.

2.4 Vacuum-Tube Circuits

Gap-Filler Sweep Circuit

(B. W. Barrett) (UNCLASSIFIED)

The limitations on recovery time of the sweep circuit are the discharge time and voltage level of the sweep capacitor, both of which depend upon other parameters in the circuit. The sweep recovery time must now be made independent of these other parameters.

Vector Generator

(E. B. Glover) (UNCLASSIFIED)

A new sweep-circuit design has been completed and appears to have several desirable features not present in the original design. However, since we are being pressed to have an operating circuit for use in Building F soon, efforts are being concentrated on checking the present circuit and keeping design changes to a minimum.

Display-Line Driver

(J. Kriensky) (UNCLASSIFIED)

During this 2-week period 16 output-stage (PU3006482) and 8 preamplifier-stage (PU3006481) pluggable units have been received and tested.

Flip-Flop, Model E

(N. J. Ockene) (UNCLASSIFIED)

An analysis of a large group of Z2177's selected at random and operated in the Model E flip-flop has shown a correlation between the behavior of the flip-flop and certain test procedures performed on the tubes. Those test procedures showing the best correlation with the flip-flop performance were the tests performed at zero grid bias and -2 volts grid bias. The correlation of the flip-flop with the 200-μa grid current test procedure was less conclusive than the other two tests.

An important point which these tests have brought out is the fact that the Model E flip-flop "sees" the bogie Z2177 as the flip-flop formerly saw a 40% "down" 5965. This raises havoc with the sensitivity margins making the flip-flop extremely sensitive.

Direct-Coupled Video Probe

(W. F. Santelmann, Jr.) (UNCLASSIFIED)

Testing of the probe system continues. Considerable trouble has been encountered in measuring such characteristics as rise time, equalization, and linearity because of the difficulty of obtaining test instruments which are themselves free of such limitations. A complete breakdown of the two new DuMont 336 oscilloscopes assigned to this group hasn't helped a bit.

The question of power for the probe when in use on XD-1 has arisen. Outlet boxes which could carry the required power exist on many frames, but none are completely wired. If they could be wired soon, the probe system could be placed in operation within a week. Otherwise, time will have to be spent in designing and building a small portable power supply.

Matrix Output Amplifier (256 x 256 Core Memory)

(D. Shansky) (UNCLASSIFIED)

A feedback amplifier, utilizing the properties of a silicon zener-diode for the purpose of defining precisely the output swing, has been designed and is being breadboarded. A total of three cathodes will be used. For an input of +10 to -30 volts, the amplifier will provide a +10 to -80-v swing at an impedance level less than 10 ohms.

Gate Generator (256 x 256 Core Memory)

(D. Shansky) (UNCLASSIFIED)

In an attempt to reduce the cathode count in this unit, a new gate generator has been designed and is being breadboarded.

XD-1 Memory

(D. Shansky) (UNCLASSIFIED)

Zopatti and I attended a discussion in Poughkeepsie regarding some of the problems in the XD-1 memory and their proposed solutions.

Sensing Amplifiers for Memory Planes

(R. C. Zopatti) (UNCLASSIFIED)

Because of the serious problems encountered with a transformer input to the sense amplifier, other types of input circuits have been tried. A difference-amplifier input seems promising. A breadboard was built with a difference-amplifier input and first amplifier stage. The circuit had an over-all gain of 30, a total delay of 0.3 microsecond, and a recovery time which would allow for a 6-μsec memory cycle without attenuating the read signals by more than 10%.

2.5 Display

(R. Fallows) (UNCLASSIFIED)

Both XD-1 central display frames are essentially complete. The MTC drum has been tied in and is working as a source of test signals to frame 25 (digital-display generator). The display tester is being used as a test source for frame 24. An experimental Typotron display has been tied in to frame 25 for use in taking equipment margins.

The display maintenance console (number 168) has been in location since 19 April but is not yet operative because of design problems in the first Crosley consoles and late delivery of console components. Bill Mercaldi of IBM is riding herd on all console materials and installation plans. Without his assistance several more weeks delay would probably have been experienced.

The special side frame for console 168 has been delivered by IBM, Poughkeepsie, together with all its cables. The design engineer, Charlie Taft, has checked out the frame and cables. We hope to have a situation display operating in the next biweekly period--as soon as the frame signals are complete (now being inspected at Kingston) and the console is operative.

The remaining work on the central display frame, which ideally should be complete before the end of system test in June, is as follows:

1. Add camera control circuitry to frame 25. This work should be complete by mid-June.

2. Complete vector-generator design and incorporate in frame 24. This work should be complete by mid-June.

3. Design vector-intensity-control circuitry and incorporate in frame 24. This work is being hampered by manpower shortage (Julie Woolf is trying to do it in his nonexistent spare time). Present indications are that the work will be complete in late July.

4. Design new point address pluggable unit and incorporate in frame 24. This work is in the same state as item 3.

5. Incorporate test mixings of categories, display-assignment bits, and mixed driver outputs in frame 24. This work should be complete by late June.

A meeting was held in Bob Everett's office on 5 May to discuss the present plans for adding category and DAB mixings to frame 24. It was agreed that, in the light of the present XD-1 operational specification status, it would be inadvisable to make an interim change in the frame wiring. The results of this meeting will be reported by Bob Buzzard in a separate memo.

The major problems in the XD-1 display installation concern console test manpower and cable deliveries.

It is necessary to make representative measurements on the signal cables to consoles in order to check our frame design. Ed Reardon and Richard Dickie have been following the cable work at IBM, and they have many interesting stories to relate. At present the DB to DB cables are about a month late.

We have been discussing and estimating the manpower needed for console installation for over a month. It appears now that Hazeltine Electronic Corp. will supply the bulk of this manpower. IBM has assigned five technicians and three engineers in the console area; most of these will be assigned later to the maintenance of XD-1 and XD-2. Hazeltine is planning to send four to six engineers and six to eight technicians to assist in the XD-1 installation and test. We are making plans to set up a training program for all of these people, so that the necessary knowledge, experience, and organization will have been built up by the time the all-out installation work starts in June.

(R. B. Paddock, R. H. Gerhardt) (UNCLASSIFIED)

All pluggable units for frame 25 have been received and installed. Initial checks and adjustments were made so that the Typotron test setup could be driven from the digital-display generator (DDG). Several inadequacies in the test setup had to be remedied first, but we now have a moderately good display on the Typotron using either the display tester or MTC to operate the digital-display generator.

We have experienced many brief but aggravating failures in pluggable units using German resistors. This is the cause of jitter now present in the voltages driving the Typotron. Many of these resistors are now being replaced with acceptable components.

The effort now is to check out the display of the entire Typotron matrix using the DDG. If time allows, marginal checking will be started to obtain initial margins on frame 25.

(H. Zieman) (UNCLASSIFIED)

I made a trip to Vestal Lab to study the differences between their display results and ours. The problem concerns secondary effects in the magnetic-deflection system which prevent complete character settling for 60 or 70 microseconds. Although these effects only amounted to 0.2% in the MTC system and 1% in the Vestal system, we decided to study the problem more thoroughly in case this effect might become more serious in other systems.

To study the problem a deflection signal would be set up in the yoke system and a short time (15 to 100 microseconds) later the beam would be intensified for 25 microseconds. The same deflection would be maintained and intensified for a second time 1 millisecond after the initial setup. If it is assumed that all transients have disappeared in 1 millisecond, then this second intensification can be used as a measure of the final rest position of the beam. To determine the time required for the beam to settle sufficiently, the time between the setup and first intensification can be varied until the first intensified character falls exactly on the second.

In both systems the two characters fall within 1% in 18 microseconds, but an additional 40 to 50 microseconds are required for the characters to superimpose exactly. This settling in both cases is from an overshot position.

It was first determined that the amplifiers were actually settling in somewhat less than 18 microseconds. To determine whether the long decay was due to the yoke or other equipment, an electrostatic tube was used with only the yoke present for deflecting the beam. It was found that the two spots would be within 1% in 18 microseconds and would require an additional 20 microseconds to coincide exactly. However, the decay was from an undershot position. An R-C network in the cathode circuit of the driver stage compensated for this, and after final adjustments the two spots could be made to coincide exactly in 18 microseconds for any magnitude of deflection. Since no such compensations had worked previously, the primary trouble apparently was not in the yoke.

The mu-metal shield used in the Charactron was next placed in position, and the spots again were separated and required 50 to 60 microseconds to coincide. An aluminum shield placed in the same position produced a similar effect. It was, therefore, decided that the trouble lay with eddy currents produced in the shield by the stray magnetic field of the yoke. Two methods of attack are now being tried. Vestal will try to eliminate the eddy currents mechanically by increasing the shield resistance, forming alternate magnetic paths for the stray field, or slotting the shield to reduce the eddy currents. We will try to reduce their effect by compensation circuits in the amplifier.

(J. Woolf) (UNCLASSIFIED)

Consoles 1 and 2 for XD-1 have arrived from Crosley and are being debugged. These consoles have to be modified to incorporate the latest changes in the deflection circuitry. They should be in operating condition within the next biweekly period.

The light gun was installed and is operating in MTC.

A set of amplifiers has been constructed on MTC panels. These will be used for Typotron deflection. The amplifiers have an output swing of 500 volts with a rise time of 2 microseconds. At the maximum output the amplifier can introduce an error in gain of 1.5%.

Because of information supplied by H. Zieman, the deflection amplifiers in MTC were tested for effects of the convergence-coil housing. Tests performed indicated that this housing introduced a time constant of 500 microseconds in the deflecting field. This phenomenon will be investigated by H. Zieman using the pre-prototype console.

Automatic Camera Control and Camera

(L. L. Sutro) (UNCLASSIFIED)

Our principal concerns have been (1) marginal checking of the system, (2) the camera mount, and (3) a timing diagram of the system based on tests. John Carlson of IBM and I have worked the wiring for marginal checking and have started to prepare a procedure. A question we are considering is whether to program as much of the check as possible or as little as possible. Since a camera cycle takes 3 to 4 seconds, it seems wise to do as little of the checking by program as possible and do the rest by pushbutton while the computer is doing something else.

2.6 Vacuum Tubes

2.6.1 Activities of Group 65

(P. Youtz, J. Palermo, F. Caswell) (UNCLASSIFIED)

At the request of the IBM-MIT Display Tube Committee we spent the last 2 weeks at the Convair Charactron tube plant studying, evaluating, and helping to revise the Convair Charactron Manufacturing Process Specifications (CMPS) so that it will completely and fully describe the actual processes at this time. As of 7 May 1955 the specifications were not completely written. However, the available CMPS seem adequate and are basically representative of the in-line production methods followed at Convair.

When Convair changed from a Sylvania electron gun to a Superior electron gun to improve the electron optics, they had a siege of cathode troubles. We spent considerable time "bird-dogging" this problem in the plant. C. L. Corderman joined us on 5 May 1955 to help with this task.

2.6.2 Tube Research and Development

(S. Twicken) (UNCLASSIFIED)

An analysis is being made in conjunction with IBM of the statistical data of the 2420 lot-evaluation program. A proposal from Sylvania for the complete gate-pentode specification is being compared with our findings. The specification limits and AQL's will be mutually agreed upon at a meeting the week of 9 May.

In an effort to determine the cause of the lower fixed-voltage plate currents of the 0528 (Z-2177), a dimensional comparison is being made of present production and old development shop tubes; $\bar{X}$ and R charts of plate currents and contact potential are being run from the punched-card data; and GE has been requested to supply a quantity of tubes right off the exhaust machine which we plan to age, stabilize ourselves, and make note of contact-potential variations with processing. The dimensional-comparison and punched-card-analysis programs are being implemented by IBM.

I attended a meeting at High Street with Sylvania to implement the IBM-MIT decision that the prime and second sources of the gate pentode should work together to insure that tubes from the two sources be identical in design and processing, insofar as is practicable.

A progress meeting at Tung-Sol on the DT-438 (improved 5998) shows the program to be moving somewhat slowly but gaining momentum. A tentative schedule, within the scope of the contract, was set up as a target. The schedule calls for acquisition of all parts and tooling by 1 July and the completion of ten weekly lots in the factory by 1 October. The present contract expires in November. It is doubtful that the schedule can be met because of tooling and parts delays, but its existence should serve to goad Tung-Sol into more positive action.

(T. F. Clough) (UNCLASSIFIED)

The Lincoln Tube Process Specifications for the 19-inch display tube have been completed except for those sections concerning general procedures and techniques. These specifications will permit a comparison of our tube procedures with those of Convair.

S. Twicken and I visited the Kingston Tube Group and discussed the results of their preliminary work on the dimensional analysis of the 0528 (Z-2177).

(L. B. Martin) (UNCLASSIFIED)

More grid-cathode leakage tests were made on Typotron tubes. Much of the leakage in the writing guns was between the heater and grid. This seems to indicate base leakage and should be relatively easy to prevent.

The stable range of the newest production Typotrons available averages about 40 volts. This is the margin between the voltage necessary to just store the characters and the voltage where the storage surface switches positive, in short, the usable collector-voltage range. Marked nonuniformity was found in some tubes with respect to lower stable voltage over the face of the tube. One tube requires 34 more volts to store in some areas over that required in other areas. In spite of this, the stable margin is 40 volts.

The following is a list of Typotron tubes, their condition, and hours on life test:

Tube	Total Hours	Condition
265	8889.4	marginal
280	8071.4	marginal
389	6368.8	satisfactory
390	6552.6	satisfactory
392	6552.6	satisfactory
394	5770.5	marginal
11521	1620.7	satisfactory
11601	1865.2	satisfactory
11981	748.3	satisfactory
12122	748.3	satisfactory
12523	748.3	satisfactory
12622	748.3	satisfactory
12641	748.3	satisfactory
12221	748.3	satisfactory
12242	311.5	satisfactory
12461	311.5	satisfactory
12522	311.5	satisfactory

(P. C. Tandy) (UNCLASSIFIED)

Eleven 19-inch Charactrons, CHT-61, CHT-62-1, CHT-72-2, CHT-73, CHT-75, CHT-80, Convair 14-1, 0082, 0083, 0199, and 0208, have completed from 166 to 4386 hours on life test. The status of these eleven tubes and the three tubes which have failed since the last report, CHT-68-1, 0187, and 0197, is shown in Table I on the following page.

It can be seen that the zero-bias pulse-matrix current dropped on all except one tube, and the maximum ratio of pulse-cathode current to pulse-matrix current rose except in two cases. The three tubes which failed to meet the 50-μa pulse-matrix-current requirement, CHT-68-1, 0187, 0197, completed 1477, 117, and 117 hours, respectively.

Table I

Tube	Last Biweekly Rpt. Hr	Pulse 0-Bias I_M	Max. $I_K:I_M$	Hr	Pulse 0-Bias I_M	Max. $I_K:I_M$	Hr	Pulse 0-Bias I_M	$I_K:I_M$	Hr	Pulse 0-Bias I_M	Max. $I_K:I_M$
CHT-61	4064	130 μa	29.7	4238	100 μa	41.1						
CHT-62-1	3955	88	18.2	4125	73	19.2						
CHT-68-1	1369	135	15.2	1477	43	55.8						
CHT-72-2	1373	195	11.6	1610	165	14.5						
CHT-73	1285	195	12.4	1522	175	12.6						
CHT-75	2707	149	16.4	2944	106	20.2						
CHT-80	2556	275	10.8	2793	235	12.5						
14-1	590	110	15.4	828	78	21.8	872	58 μa	27.2			
0082	1121	245	36.2	1294	119	40.6	1413	81	68			
0083	475	360	9.7	712	335	9.1						
0187				0	255	11.9	117	33	62.8			
0197				0	385	13.4	117	15	390			
0199				0	465	12.5	115	180	181	135	110	200
0208				0	300	13.5	116	320	13.5			

Cathode uniformity of five tubes was checked at 20% pulse-duty cycle. Tubes 0187, 0197, and 0199 had poor uniformity, 0187 had only fair uniformity, and 0208 had good uniformity. Tubes 0199 and 0208 were observed after 93 hours on life, 0187 and 0197 after 111 hours, and 0083 after 715 hours.

Leakage tests, gas tests, and aluminum screen-backing capacitance and dissipation-factor tests were made on all the tubes except 0187, 0197, 0199, and 0208.

No leakage was noted on CHT-68-1, CHT-75, CHT-80, 14-1, 0082, 0123, and 0124. The leakage currents of the other tubes are noted in Table II.

Table II

Tube	Hours	Element	-3400-v Leakage Current
CHT-61	4150	S_1	0.18 microamperes
CHT-62-1	4035	S_1	39 microamperes
		S_{1-4}	19 microamperes
CHT-72-2	1451	S_1	32 microamperes
		S_{1-4}	32 microamperes
CHT-73	1361	A_2-Matrix	0.78 microamperes
14-5	443	C_3	0.3-0.8 microampere
0083	641	S_3	0.10 microampere
		S_2	0.12-0.62 microampere
0127	476	C_4	0.36 microampere

The leakage-current limit is 1 microampere.

The only significant change in the gas test was found on 0082. The ion current changed from 16 millimicroamperes at 0 hours to 28 millimicroamperes at 1205 hours. The gas test could not be made on 0127 because the cathode current was less than 100 microamperes.

The screen capacitance, C, and dissipation factor, D, had changed from previous test values on 0124 and CHT-73. The results on these two tubes are shown in Table III.

Table III

Tube	Previous Test			Latest Results		
	Hours	C	D	Hours	C	D
0124	0	371	0.0255	443	324	0.0084
CHT-73	592	122	0.086	1361	121	0.038

It should be noted that the reading on CHT-73 at the start of life was C = 345 and D = 0.01.

The only tube to show a change in helical-accelerating-electrode resistance was 0124. It changed from 132.3 megohms at 0 hours to 109 megohms at 443 hours.

A Convair Charactron gun with a Superior Electronics 5CP was used in CHT-90R1. The cathode uniformity of this tube was poor. Upon inspection the cathode appeared to have had a piece of cathode material chipped out.

Work is continuing on expanding the life test to 20 positions. The life test of up to 15 Charactrons will be continued. Starting the week of 9 May, data taking will be discontinued for as short a period as possible while I am writing my Master's thesis.

2.7 Memory Test Computer

(W. Hosier) (UNCLASSIFIED)

The display-testing connection to Building F has been checked out, and pulses from a display pattern stored on two 32-bit fields of the MTC drum are received as desired. Because of assorted minor troubles with the DD display-generating frames and lack of proper programs, the actual patterns thus displayed on the Typotron have been quite limited, but the next week should see transmission and reproduction of a more orthodox test pattern. As soon as the Crosley test console and suitable SD programs have been checked out, a pattern can likewise be transmitted for Charactron situation display.

At a meeting in Poughkeepsie on Friday, 6 May, with the GFI (gap-filler radar input or SDV) people of IBM, it was tentatively agreed to supply MTC facilities for closed-loop testing of the GFI apparatus. Programming for and supervision of this test from the MTC end will be carried on by John Newitt of the MTC Section; on the other end John Wilbert and Ralph Washburne of IBM will cooperate in planning of tests.

Computer scheduling and operation have continued in substantially the usual manner with the exception of an intermittent flip-flop difficulty in the program counter (diode with low back resistance, similar to the A-register trouble reported at length in the Biweekly for 11 March 1955). This failure did not render the computer inoperable for all purposes, but for programs involving start-stop operation (such as conversion, camera operation, card punching) it was virtually useless until the flip-flop was tracked down, losing about 11 hours' time.

Assigned Computer Time

Application	Hours	Per Cent
Programming	144.65	58.2
Development	42.00	16.9
Maintenance & Marginal Checking	17.28	7.0
Installation	3.97	1.6
Reliability Check Programs*	29.13	11.7
Interrupting Failures	11.42	4.6
	248.45	100.0

* In the absence of other scheduled operations, particularly on the "graveyard" shift, the computer is run continuously on self-checking programs, any errors then occurring being ascribed to "interrupting failures."

(B. Farley) (UNCLASSIFIED)

Consideration is being given to characteristics of an MTC assembly program, including card and tape layouts, program formats, etc. Suggestions will be entertained from interested sources.

(J. H. Newitt) (UNCLASSIFIED)

During the past period I have written several successful practice programs and have started a detailed study of the logic and electronics of the MTC machine.

Drums

(E. Gates) (UNCLASSIFIED)

The link between MTC and Building F has been completed. Fixed patterns have been stored on the drum so that the display equipment in Building F could be adjusted.

Two more fields have been added to the drum, making a total of ten fields available to programmers. The remaining two fields will be working as soon as a head-mounting bar for them is milled to the correct size so that the heads can be adjusted properly.

(F. Durgin) (UNCLASSIFIED)

It appears that addressing the MTC drum with interleaf as now used, on the one hand, and high-speed block transfer of consecutive registers, on the other hand, are basically incompatible. Opinions and suggestions are requested concerning the supplanting of the present system by a drum which operates only as storage.

Card Machine

(F. Durgin) (UNCLASSIFIED)

Two features are being added to the card machine. One is the ability to easily distinguish MTC cards from XD-1 cards via an identification punch. This punch will be an "M" and will be punched in column 1 of the IBM card. The second feature is the ability to gang punch into all cards the information inserted via a lead card. The lead card is punched on a standard manual keypunch.

Scope-Display System

(H. Ziegler) (UNCLASSIFIED)

Addition of a "floating" bias power supply to the display scope decreased but did not eliminate the prf sensitivity in display intensification. This fact was brought out by a special test program recently written. The source of the remaining prf sensitivity was found to be in the plug-in intensification amplifiers which are scheduled to be replaced soon by a new design. Circuit modifications have eliminated the difficulty with the present amplifiers, and they should serve passably well until the complete display-system changeover takes place in about 2 months.

Analysis of MTC Tube & Component Defects

(B. Searle) (UNCLASSIFIED)

The following is a summary, for the period 8 April to 6 May, of defects found in tubes and in components in MTC:

Tube or Component	Defect	Number	Hours Lost
6145	Tap short	7	0
6AG7	Shorted	1	0
Diode, type 1N34A	Back resistance too low	9	1.44
Toggle Switch	Intermittent	1	0
Toggle Switch	Open	1	0
Resistor	Changed value	1	0
		20	1.44

III. ADVANCE DEVELOPMENT

(D. R. Brown) (UNCLASSIFIED)

Pilot production and testing of memory cores continue at a high rate, and the first 256 x 256 memory plane has been assembled.

Plans and time schedule for advance development are receiving careful consideration in the Group. Particular attention is being given to experimental systems. Two of these are planned. The first will be an eight-digit multiplier to be finished in several months, and the second will be a complete central computer to be finished over a year from now. The multiplier is expected to demonstrate high-speed transistor circuits using Philco surface-barrier transistors, and the computer is expected to combine a transistor arithmetic unit and control with the 256 by 256 by x magnetic-core memory.

3.1 Chemistry of Magnetic Materials

Inorganic Chemistry

(D. G. Wickham) (UNCLASSIFIED)

Magnetic moments for compositions in the solid-solution range between ferrous germanate and zinc ferrite have been measured at liquid nitrogen temperature (-196C) with the following results:

Composition		Moment (μ_B/molecule)
Fe_2GeO_4 -	$ZnFe_2O_4$	
20%	80%	4.56
30	70	3.60
40	60	3.35
50	50	4.91
60	40	2.14
70	30	1.77
80	20	1.44

The effects of various preparative conditions on the magnetic properties are now being studied.

Thermal Stability of Magnetic Spinels

(F. S. Maddocks) (UNCLASSIFIED)

A-c pickup by the differential thermocouple in the thermal-analysis furnace has been reduced to about 25 microvolts at 1200C. This value is apparently the best obtainable without structural changes to the furnace, and it should not limit the usefulness of the furnace.

Experimental Ferrites

(D. L. Brown, F. E. Vinal) (UNCLASSIFIED)

Some new compositions in the magnesium-manganese ferrite system are being investigated for possible switch-core application. A few of them possess high magnetic moments, but their Curie temperatures are possibly around 150C.

The lithium ferrite investigation is being continued. The effects of manganese and zinc ferrite additions are the present objectives.

The preparation of the magnesium-copper ferrite series has been delayed temporarily to permit the installation of new electrical equipment.

Chemical Analysis

(E. Keith, P. Reimers) (UNCLASSIFIED)

Quantitative analyses of the following have been completed:

1. DCL-2-836 and DCL-2-261F, memory-core compositions;
2. A sample of magnesium fluoride.

Quantitative analyses of the following are in progress:

1. DCL-2-840, a memory-core composition;
2. DCL-8-36, a sample of copper chromite;
3. A sample of lithium ferrite.

Chemical Synthesis

A sample of sodium ferrite was synthesized.

Pilot Production of Memory Cores

(J. J. Sacco) (UNCLASSIFIED)

Approximately 200,000 memory cores were produced in the ceramics laboratory pilot plant during this biweekly period. Test results of the first 90,000 show an acceptance yield of 98%.

The production of unfired cores has been doubled, and with the new core-loading techniques, it is now believed that a production rate of 240,000 fired cores a week can be maintained.

Core Testing

(J. Schallerer) (UNCLASSIFIED)

During this biweekly period 135,000 cores were double-tested. The cores were almost all tested on the semiautomatic tester. The automatic tester, which has been inoperative for most of this period, will be operating again for the next biweekly period.

To date, 600,000 cores have been double-tested.

3.2 Physics of Magnetic Materials

Saturation Magnetization Measurements

(D. O. Smith, J. B. Goodenough) (UNCLASSIFIED)

The magnetic moments of powdered samples in the $(Zn,Ge)Fe_2O_4$ series are being measured as a function of temperature from - 195 C to room temperature. Measurements on a sample of 70-30 Zn-Ge ferrite show that saturation is not attained until fields of 10,000 oe. are applied. The magnetic moment at room temperature is 2.04 μ_B per molecule, where μ_B is a Bohr magneton and increases linearly from -50 to - 195 C. Extrapolation of this linear curve gives an upper limit for the saturation magnetic moment at 0 K of 5.1 μ_B per molecule. This figure suggests that both Ge^{2+} and Ge^{4+} ions are present, and that if a sample with only Ge^{4+} ions can be prepared, a ferromagnetic spinel with Curie temperature greater than room temperature will result.

Incremental Permeability at Remanence

(J. D. Childress) (UNCLASSIFIED)

To demonstrate the validity of the equation for half-select voltages, $e(t) \propto \mu_\Delta \, dH/dt$, the equation of wall motion for an ellipsoidal domain has been derived. For suitable assumptions, the equation reduces to the Ricatti form which is difficult to solve in closed form but can probably be solved by series methods.

Magnetostriction

(N. Menyuk) (UNCLASSIFIED)

Magnetostriction measurements on single crystals of manganese and nickel ferrite have begun. A discrepancy has been found between the experimental values of the magnetostriction of these samples in the 111 direction and the results predicted theoretically. The cause of this discrepancy is being investigated.

Switching and Signal Coefficients

(J. R. Freeman, J. W. Schallerer) (UNCLASSIFIED)

A simple analysis of the analytical expressions relating the peak undisturbed ONE voltage outputs and the switching times of magnetic cores to the driving current suggests that the saturation flux density, B_s, is directly proportional to the product of the switching coefficient, S_w, and the signal coefficient, S_v (the derivative of $_uV_1$ with respect to driving current).

J. Schallerer selected three samples of F262 DCL cores and measured S_v, S_w, and B_s for each. The prediction that $(S_v S_w / B_s)$ is constant was confirmed.

3.3. New Components and Circuits

Manpower Requirements

(T. H. Meisling) (UNCLASSIFIED)

A detailed estimate has been made of manpower requirements for the design of a proposed minimum computer. The estimate includes engineering tests of breadboard prototypes but does not include any final layout and construction.

Transistor Life Tests

(D. J. Eckl) (UNCLASSIFIED)

There are now 155 surface-barrier transistors in operating circuit life tests. Ninety-nine transistors in the shift register have been operating 509 hours. This shift register has now held a 11001000 pattern unchanged for 2 weeks (356 hours). Two ring oscillator clocks (direct-coupled and RC-coupled) have been in operation for 218 and 169 hours, respectively. These units had their transistors removed (16 in each) after 150 hours and re-measured. No change in parameters was measurable. The tests so far represent 135,175 transistor hours with one failure (not attributable to transistor deterioration).

Transistors

(P. A. Fergus) (UNCLASSIFIED)

Routine measurements of alpha have been made on 120 more G.E. pnp junction transistors. These are very uniform, and alpha has a value of about 0.97.

Routine measurements of alpha, I_{co}, and I_{eo} have been completed on the 300 Philco surface-barrier transistors. Distribution curves of α_N and α_I indicate a somewhat higher trend in the values of α_I.

Routine measurements have been made on two Transitron pnp junction transistors.

Pulse Generator Circuits

(M. E. Petersen) (UNCLASSIFIED)

The possibility of using delay lines to generate pulses of accurately controlled width and amplitude at pulse repetition rates above 5 megacycles is being investigated.

A circuit now being used will generate 50-μsec pulses at rates up to 3 megacycles when driven by a square-wave generator. The maximum pulse repetition frequency is determined by hole-storage time in the transistors saturated to generate the pulse.

Recovery Time in Surface Barrier Transistors

(C. T. Kirk) (UNCLASSIFIED)

Theory predicts that the minimum recovery time of a surface-barrier transistor is in the order of 10^{-9} seconds. In practical units, however, this fast switching transient is masked by a slower transient which has a switching time in the order of 10^{-7} seconds. The fast recovery time is the time required to remove holes from the base in the region between the emitter and collector. By applying a positive voltage step to the base, we can reduce the switching time of the base region between the emitter and collector to the order of magnitude given by the theory. The slower recovery time is thought to be due to holes trapped in the outer extremities of the base region. Unfortunately, the holes in this region cannot be affected by external conditions, and their removal is due to diffusion to the emitter and collector and to decay due to surface recombination.

There is considerable evidence that the removal of these holes can be accelerated by increasing the recombination rate of the surface; consequently, the switching time during the recovery phase of the transistor will be reduced.

3.4 Memory

256 x 256 Memory

(E. A. Guditz) (UNCLASSIFIED)

The prototype 256^2 memory plane is assembled and ready for tests.

Fifty mats have been made to date. These contain x, y and digit wires and, in most cases, half a sense winding. When the mats are installed in frames the wiring will be completed.

A prototype 256^2 support frame is being constructed.

256 x 256 Memory (cont'd)

(J. Raffel) (UNCLASSIFIED)

The first complete 256^2 memory plane should be received from Guditz in a few days. At this time tests will be run to determine the memory-plane noise, digit-plane-driver impedance, and other factors which will determine many crucial design points.

256 x 256 Memory (cont'd)

(J. L. Mitchell) (UNCLASSIFIED)

The final model of the core-switch plug-in unit has been received from the shop and will be wired as soon as technician time is available.

Time schedules for the 256^2 memory have been reviewed and revised. The memory should be completed in early 1956.

The preliminary design of the racks and stall has started. The effort on this design will increase as soon as the final design of the vacuum-tube plug-in unit is available.

Plug-in Unit

(E. A. Guditz) (UNCLASSIFIED)

Drawings of this unit are almost completed. Sheet-metal

work is expected to start before 1 June.

Memory Test Setup VIII

(D. H. Ellis, S. Bradspies) (UNCLASSIFIED)

Design of the circuit for driving the crystal matrix has been completed. Breadboard panels are being constructed.

Layout of the driver panels is complete, and the shop is punching the holes.

The physical arrangement of the test setup has been worked out, and the racks and equipment are being assembled.

XD-1 Memory

(J. L. Mitchell) (UNCLASSIFIED)

A study of the XD-1 memory has started. The object is to determine why the margins are low on some programs and why the data obtained from memory tests does not correlate with that obtained from MTC. Early results indicate the first thing that should be done to the XD-1 memory is to improve the decoupling on the d-c lines feeding the selection-plane drivers.

Transistors for Memory

(J. Raffel) (UNCLASSIFIED)

Preliminary tests are being run on different transistors to determine if any available commercial models could be used to drive memories. Methods are being investigated for using the transistors in circuit arrangements which relax speed and power requirements.

Transistor Drive

(G. Davidson) (UNCLASSIFIED)

Some work has been done on d-c tests of the Minneapolis-Honeywell H-4 transistor in order to become acquainted with the

magnitudes of current, voltage, and power dissipation experienced when using this transistor as a switch. With the emitter grounded and the transistor in the saturated state, the power dissipation remains constant over wide swings of collector currents and is in the 100-mw range. The turn-on and turn-off times are probably more important than finding a transistor with high power dissipation.

A thesis proposal on the above general subject is being written, although a thesis supervisor has not yet been contacted.

3.5 Logical Design

(N. L. Daggett, J. W. Forgie, W. A. Clark) (UNCLASSIFIED)

The block diagram of a skeletal machine (tentatively named TX-0) is available as sketch number SB-62587. This machine is intended to be a small, simple, general-purpose computer which will accommodate a large magnetic-core memory. Programming simplicity and computing speed have been secondary considerations in the design. Circuit operating conditions and speed requirements have been kept consistent with the needs of a large-scale computing system.

TX-0 is an 18-bit, parallel machine. The instruction word is divided into a 16-bit address and a 2-bit operation code. This division permits random access to a full 256 x 256 (65,536 registers) memory with a minimum word length consistent with program generality and operating speed. Three of the four instructions (add, store, and transfer control on negative accumulator) refer to storage locations. The fourth instruction, called "operate," utilizes the 16 bits of the address section to select any combination of 16 possible operations (e.g., read in, read out, clear AC, complement AC, cycle right 1, halt) which do not refer to memory. This operate order is, in a sense, a micro-programmed instruction which permits the programmer to perform any combination of a few basic commands which he finds convenient.

The TX-0 machine has only three electronic registers--memory address register (MAR), memory buffer (MB), and accumulator (AC). The function of a program counter is performed by one of the memory registers. We believe three to be the minimum number of registers consistent with the logical requirements of general-purpose computation and the electronic requirements of the memory in question.

In accordance with the requirements for the accumulator of TX-0, the design of the proposed test multiplier has been changed. The new multiplier design utilizes a full carry followed by a shift on each addition of the multiplication cycle, rather than a shift-and-carry operation as used in WWI. The result is a slower multiplication,

but a considerable saving in equipment is achieved by the elimination of carry flip-flops. Control for the test multiplier is being redesigned to permit this slightly different method of multiplication.

3.6 Systems Design

(Jonathan Fadiman, Robert Hughes) (UNCLASSIFIED)

Transfer lines of one digit of the computer have been simulated to study noise and termination problems. It seems now that open wire leads only a few feet long will have to be terminated because of the fast rise times we are using.

(D. Parfenuk) (UNCLASSIFIED)

One module of the computer is being assembled to try out the proposed packaging scheme. If it is successful it may be used in the multiplier.

The A.M.P. power taper pin crimper has arrived and is being set up.

(R. Sawyer) (UNCLASSIFIED)

It seems unlikely that transistors will be available to drive the memory vacuum-tube drivers with the 40 or 50 volts they need, so for the present it is assumed that the drivers will be preceeded by a 5965 amplifier which needs only 9 volts drive. Experiments seem to show that voltage doublers made with two SBT's will give 9 volts when driven from our flip-flop levels of from 1 to 4 volts.

(C. Norman) (UNCLASSIFIED)

Several careful plots have been made of certain transistor characteristics that are significant in display decoders and also give a measure of the noise sensitivity of a system.

IV - CENTRAL SERVICES

4.1 Material Requirements & Stock

(H. B. Morley) (UNCLASSIFIED)

We are investigating the possibility of obtaining Quadruple Formvar magnet wire in colors. This wire would be useful for identification purposes in memory planes and switches, etc.

The requisition for the high-speed punch for MTC output has been processed.

We have been cooperating with K. Olsen's TX-1 Computer Section in obtaining data on new products.

4.2 Engineering Services

4.2.1 Components

(H. W. Hodgdon, C. Morrione, R. J. Biagiotti) (UNCLASSIFIED)

We conferred with William Ogletree and Carl Wood of Burroughs on component selection and inspection problems in AN/FST-2 equipment. Also present were H. Heath and A. Lampe of IBM.

Space in the basement of Building D was obtained for Components Section life-test equipment.

4.2.2 Test Equipment

Test Equipment Headquarters

(L. Sutro, A. Bille) (UNCLASSIFIED)

There is a possibility that 15 power supplies variable from 0-300 volts will shortly be available. These supplies have belonged to the lab since its early days and yielded 225 milliamperes at 250 to 300 volts. Their regulation and output ripple are excellent, but because of their limited voltage swing they have gone out of use. A circuit modification now being tried should permit each supply to yield any voltage from 0-300, which is the range now wanted.

4.2.3 Mechanical Engineering

(A. R. Smith) (UNCLASSIFIED)

Another step has been completed in expediting production of the 256 x 256 core memory: the adaptation of a standard drill press with multi-drill head, jigs, and fixtures which will precisely drill 272 terminal lug holes in each module frame in less than 10 minutes.

4.3 Drafting

Drafting Equipment

(A. M. Falcione) (UNCLASSIFIED)

In the past few months, many of our draftint templates, curves, and drafting aids have been removed or borrowed, causing delays in our operations. It would be greatly appreciated if all borrowed drafting equipment is returned as soon as possible. These items may be taken out on a loan basis when required by Division 6 personnel.

SAGE Test Committee Memoranda

(A. M. Falcione) (UNCLASSIFIED)

A group of a thousand numbers, beginning with 6M-5000, has been reserved for a series of memoranda to be issued by the SAGE Test Committee. The numbers may be obtained from the Division 6 Document Room (C-129). A basic standard distribution list, on Multilith masters, is available in the SAGE Test Office (C-184C). It is recommended that secretaries consult Memorandum 6M-5000 for details and procedures for SAGE Test Committee memoranda.

4.4 Administration and Personnel

4.4.1 Staff

New

(J. C. Proctor) (UNCLASSIFIED)

Frank Hazel is a new staff member in Group 60, replacing John Bennett. Mr. Hazel has been employed by Sylvania. His experience includes a wide range of activities in engineering, publications, and public relations.

Lois Pearson is a new staff member in Group 61. She received her BS from Regis and was employed by General Electric.

Russel R. Shorey is a new staff member assigned to Group 66. Mr. Shorey received his SB from MIT and was employed by the American Geographical Society.

Donald O. Smith is a new staff member assigned to Group 63. He recently received his Ph.D. from MIT.

4.4.2 Non-Staff

(R. A. Osborne) (UNCLASSIFIED)

New

John Byrant is a Laboratory Assistant who has joined Group 61 to learn to be a computer operator.

Daniel Davis is a new clerk in the XD-1 Programming Section of Group 61.

Elizabeth Hatch has transferred from Cambridge to be a secretary in the ADES group.

Terminations

Judith Brask
Perryno Alexander

Transfer

Warren Hollis has transferred from the Components Section of Group 60 to the Lincoln Standards Office as an Administrative Assistant.

Open Requisitions

1 Clerk for the Print Room
1 Clerk for Group 61 (IBM Operator)
1 Clerk for Group 62 (Systems Section)
1 Clerk-Typist for Group 61
1 Checker for Group 60
1 Lab Assistant for Group 63
1 Layout Draftsman for Group 60
1 Secretary for Group 61
2 Technical Assistants for Group 61
1 Technician C (Female) for Group 63 (Memory Section)

Accessions List

(D. B. Helwig) (CONFIDENTIAL)

The following documents were published by Division 6 or received from IBM during the period 25 April - 9 May 1955:

NO.	AUTHOR	TITLE	CLS.
6M-3352	T. Clough E. Searle	Vacuum Tube Failures During the Month of January 1955	U
6M-3439-2	R. Buzzard	Large Board Display	C
6M-3448	J. Levenson	Some Post-Test Data-Reduction Program for the 1954 Cape Cod System	C
6M-3499	L. Jeffrey	Study of FSQ-7 Cycle-Time	C
6M-3529	L. Sutro	Test Equipment Committee Meeting 1 April 1955	U
6M-3530	F. Vinal	Improved Memory Cores Produced in Lincoln Laboratory	U
6M-3531	A Mathiasen B. Stahl	Raydist Calibration of Radars	C
6M-3546	R. G erhardt	Internal Publications on the AN/FSQ-7 (XD-1) Display System	C
6M-3548	P. Bagley	Proposal for the Establishment of a Sage Programming Information Service.	U
6M-3552	Div. 6 Staff	Biweekly Report for 22 April 1955	C
6M-3553	TCSS, Gr. 61	Cape Cod System Weekly Operations Schedule (WOS 17-55)	U
6M-3554	Smalley, A. L	Cape Cod System Mission Specification 55-55 for a Holmes Mission to be Conducted 26 April 1955	U
6M-3556	TCSS, Gr. 61	Cape Cod System Weekly Operations Schedule	U
6M-3558	Shoolman, A.R.	Comments on Facilities for Setting Situation Display Console Expansion Areas	U
6M-3559	L. H. Crush	CC Mission Specs. (54-55) for Eight Power Level (PL) Tests to be Conducted Tues. thru Fri. 3 thru 6 May 1955	U
6M-3561	A. Smalley	CC System Mission Specs. (52-55) for a Series of FGD Missions to be Conducted 28 April thru 6 May 1955	U
6M-3562	L. Sutro	Test Equipment Committee Meeting 22 April 1955	U
6M-3564	A. P. Hill	Syllabus for the Sage System Familiarization Program 9 May - 20 May 1955	C
6M-3565	W. I. Wells F. E. Heart	Sage Requirements on Radar Data Inputs S	S
6M-3566	A. Heineck	A Guide to Systems Operation	C
6M-3567	J. F. Jacobs	Study of Proposal to Modify and Use One-Half the FSQ-8 Equipment at Syracuse for Program Adaptation Program Revision and STP Checkout	C
6M-3569	H. Anderson	Minutes of Sage Experimental Subsector Planning Approval Committee Meeting 25 April 1955	C

Accessions List (Continued)

NO.	AUTHOR	TITLE	CLS.
6M-3570	H. Anderson	Air Force Personnel Required for the Experimental Subsector	C
6M-3571	E. D. Lundberg	Sage System Meeting 2 May 1955	U
6M-3573	TCSS	CC System Weekly Operations Schedule	U
6M-3573,A#1	TCSS	CC System Weekly Operations Schedule	U
6M-3574	A. L. Smalley	CC System Missions Specs. No. 53-55 for Two Simulated Training Missions on Wednesday and Thursday 4 and 5 May 1955	U
6M-3575	R. Everett A. Kromer	Space for Non-Lincoln Personnel Associated with Operation of XD-1 Experimental Subsector (Office Space)	C
6M-3577	L. H. Grush	CC Missions Specs. (56-55) for Eight Power Level (PL) Tests on Tues. Wed. Thurs. and Fri, 10, 11, 12 and 13 May 1955	U
6M-3578	L. H. Grush	CC Missions Specs. (57-55) for Blip-Scan (C) Range Tests to be Conducted on Tues. Wed. Thurs. Fri. 10, 11, 12, 13 May 1955	U
6M-3580	A. L. Smalley	CC System Mission Specs. (58-55) for Track Initiation (IB) Mission on Wed. 11 May 1955	U
6M-3581	A. L. Smalley	CC System Mission Specs. (62-55) for Radar Mapping Missions on Tues. and Friday, 10 and 13 May 1955	U
6M-3582	D. R. Israel	CC System Mission Specs. (60-55) for a Track Monitoring T est on 12 May 1955	U
6M-3589	J. Giordano	IBM-SO Concurrence Meeting No. 26 Held at Lincoln Laboratory, May 5, 1955	U
		IBM DOCUMENTS	
IBM-729	R. Cunningham	Card Assemblies Released for AN/FSQ-7	U
IBM-730	H. Kurkjian	Listing of AN/FSQ-7 System Test Plans	U
IBM-731	J. Brownlow A. Schenfelder	Project High Progress Report on Ferrite Core Research	U
IBM-732	W. N. Triest	Saturable Reactor Switches for Magnetic Drums	U
IBM-733	F. Grace	Third Quarterly Progress Report Diode Development	U
IBM-734	--------	Central Reference Room Bulletins 77	U
IBM-735	--------	Central Reference Room Bulletins 78	U
IBM-736	P. R. Bagley J. MacDonald	Some Descriptive Information of Value in Programming XD-1	U
IBM-737	E. L. Johnson	Programming for Teletype Inputs	U
IBM-738	--------	Programmers Reference Manual--Control	U
IBM-739	R. Whitehorne	Additional Tie Line from IBM Poughkeepsie Switchboard to Lincoln Laboratory Switchboard	U
IBM-740	R. Cunningham	Card Assemblies Released for AN/FSQ-7	U
IBM-741	R. Seversen C. A. Branson	Logical Block Symbols for Decoders	U

Accessions List (Continued)

DIVISION 6 LL-DR REPORTS

NO.	AUTHOR	TITLE	CLS.
DR-224	R. Nienburg	Concurrence on AN/FSQ-7 Equipment List (IM-102-2)	U
DR-225	B. Morriss et al	Concurrence on D-72	U
DR-226	R. W. Lowrie et al	Supplement 4 to the Specifications for the AN/FSQ-7 Auxiliary Console	U
DR-227	R. W. Lowrie et al	Display Console Side Frame Specs., (D-75-1) P-156-1, (for XD-1, XD-2 and Prod. Mach.)	U
DR-228	J. Carson	Ferrite Memory Cores Concurrence (Letter)	U